REMARKS

Claims 22-27 and 46 are pending in the application. The Office Action indicates that claims 22-27 are allowable and that claim 46 is rejected. Reconsideration in view of the above amendments and following remarks is respectfully requested.

Specification

The Office Action requires amendments to the specification in order to comply with 35 U.S.C. § 112, first paragraph. The foregoing changes to the drawings and specifications correct various typographical errors. Figs. 1-4 have also been revised to correct typographical errors and/or to make the figures consistent with the written description. Revised Figs 1-4 are attached hereto with the changes indicated in red-line. No new matter has been added.

It was also stated in the Office Action that the application did not contain an Abstract. An Abstract in compliance with 37 CFR 1.72(b) was provided in Applicant's preliminary amendment that was provided with the response to Notice to File Missing Parts filed on March 8, 2002. The Abstract was included on separate page 47 of the substitute specification that was provided. Applicant respectfully submits that the Abstract, as provided, is in compliance with the stated requirements. For convenience, a duplicate copy of the abstract as previously submitted is included with this Amendment.

Claim Rejections

Claim 46 is rejected under 35 U.S.C. 102(e) as being anticipated by patent publications US 2002/0005803 A1 and US 2002/0053982 to Kevin W. Baugh *et al.* (the "Baugh publications"). Section 102(e) of 35 U.S.C. provides, in relevant part, that a person shall be entitled to a patent unless "the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent..." (emphasis added).

The present application and both of the referenced Baugh publications have been assigned to a common assignee, Lockheed Martin Mission Systems. The assignment for the application corresponding to Publication US 2002/0005803 A1 (which issued as U.S. Patent No. 6,522,295 on February 18, 2003) is recorded at reel 12052, frame 0068. The assignment for the application corresponding to Publication US 2002/0053982 (Application No. 09/982,948) is recorded at reel 12286, frame 0052. The assignment for the present application is recorded at reel 12712, fame 0414. Because the Baugh publications are assigned to a common entity, the Applicant respectfully submits that they are not available as prior art under 35 U.S.C. 102(e).

Claim 46 is also rejected under 35 U.S.C. 102(b) as being anticipated by U.S. Patent No. 5,534,868 to Gjessing *et al* ("Gjessing"). Gjessing describes a system and method for the detection and measurement of atmospheric air movement irregularities by means of electromagnetic waves emitted from a transmitter and received by a receiver. Specifically, Fig. 1 of Gjessing depicts a "transmitter generally denoted 1 with an antenna or antennas 1A and 1B [that] cooperates with a receiver generally denoted 2 having an antenna or antennas 2A. Thus, two or more antennas (apertures) can be provided at the transmitter 1 and/or the receiver 2." (Col. 3, ln. 43-48). However, the system of Gjessing, as shown in Fig. 1, also requires a separately broadcast reference frequency: "For this demodulation, a reference frequency F_{REF} is transmitted by means of a separate channel or path in which antennas 13 and 23 are incorporated." (Col. 4, ln. 21-24). The requirement in Gjessing for a "common reference independent of" an irradiated energy beam is also reiterated in all claims of the issued patent. In contrast, claim 46 of the present invention recites, "providing an estimate for a delay of scattered signal components within said received data" (emphasis added) and does not require a reference signal that is independent of the waveforms emitted from the transmitter. Thus, Gjessing fails to disclose the features of claim 46. Therefore, Applicant respectfully submits that claim 46 is distinguishable over Gjessing. Applicant therefore respectfully requests withdrawal of the rejection of claim 46 under 35 U.S.C. § 102.

CONCLUSION

In view of the foregoing, Applicants submit that this application is in condition for allowance, and such disposition is earnestly solicited. If the Examiner believes that the prosecution of this case might be advanced by discussing the application with Applicants' representative, in person, or over the telephone, we would welcome the opportunity to do so.

EXCEPT for fees payable under 37 CFR §1.18, the Commissioner is hereby authorized by this paper to charge any additional fees during the entire pendency of this application, including fees due under 37 CFR §1.16 and 1.17 which may be required, including any required extension of time fees, or credit, any overpayment to deposit account No. 50-1349. This paragraph is intended to be a constructive petition for extension of time in accordance with 37 CFR §1.136(a)(3).

Respectfully submitted,

Dated: April 30, 2003

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Attachment: Appendix (Marked to Show Changes Made)

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APPENDIX
(Marked to Show Changes Made)

IN THE SPECIFICATION:

Please replace the paragraphs of the specification as follows:

[00007] Future airborne radar systems may operate in a difficult environment where the detection of small and maneuverable targets may occur against a strong clutter background and jamming operations. Directed beams of energy from transmitters may be susceptible to jamming countermeasures and detection. Power aperture increases may not be effective to overcome these limitations and countermeasures against radar detection. Thus, future systems may desire increased sensitivity without increasing power requirements. This condition may be applicable especially to radar systems where the transmitter power is not controlled by the receiving party.

[00008] Mobile radar systems often operate in the presence of jamming interference and monostatic clutter that are produced naturally by ground reflections. Difficulties may arise if both the transmitter and receiver are in motion, such as an airborne radar system[s]. When both the transmitter and receiver of a radar system are in motion, the rank of the clutter covariance may be increased. An increased number of degrees of freedom in the receiver system may be needed to achieve a specified level of clutter suppression. Thus, a transmitter or receiver in motion may increase the clutter interference with a signal, or increase the complexity within the receiver in accounting for the increased degrees of freedom.

[00012] According to another disclosed embodiment, a method for generating a sensor signal for a received signal within an adaptive broadcast radar system is disclosed. The method includes defining a clutter component for the received signal at a receiver. The clutter component comprises a direct path signal and a scattered signal. The method also includes defining a channel transfer function. The method also includes generating a sampled version of the received signal according to the channel transfer function at a sample time. The method also includes determining a batch of data from the sampled version for a sub-aperture of the receiver at the sample time. The method also includes indexing the batch of data into the sensor signal model.

[00016] Additional features and advantages of the invention will be set forth in the description which follows, and in part will be apparent from the description, or [maybe] may be learned by practice of the invention. The objectives and other advantages of the invention will be realized and attained by the structure particularly pointed out in the written description and claims hereof as well as the appended drawings.

[00017] The accompanying drawings, which [is] are included to provide further understanding of the invention and [is] are incorporated in and constitutes a part of this specification, illustrate[s] embodiments of the present invention and together with the description serves to explain the principles of the invention. In the drawings:

[00028] Receiving system 100 represents a family of multi-static wide area target surveillance sensors. Receiving system 100 [system] exploits continuous wave ("CW") electromagnetic energy. Preferably, receiving system 100 may receive transmissions from a plurality of transmitters 110, 112, and 114. Preferred embodiments of the transmitters for use in an adaptive broadcast radar system are disclosed below in greater detail. Transmitters 110, 112, and 114, however, may include any device, system or means to transmit uncontrolled signals.

[00029] Transmitters 110, 112, and 114 may transmit wideband electromagnetic energy transmissions in all directions. Some of these transmissions are reflected by one or more targets of interest 150 and received by [PCL] receiving system 100. For example, reflected transmission 130 may be reflected by target 150 and received by receiving system 100. Further, with regard to transmitter 114, reference transmission 140 may be received directly by receiving system 100. Receiving system 100 may compare reference transmission 140 and reflected transmission 130 to determine positional information about one or more targets of interest 150. Reference transmission 140 also may be known as a direct path signal. Reflected transmission 130 also may be known as a target path signal. Positional information may include any information relating to a position of target 150, including location, velocity, and acceleration from determining a time difference of arrival ("TDOA"), a frequency difference of arrival ("FDOA") and an angle of arrival ("AOA").

[00030] Receiving system 100 may comprise different components, including receiver 102 and processing unit 104. According to the disclosed embodiments, transmitter [111] 110 may be a transmitter array, while receiver 102 may be a receiver array. Transmitter [111] 110 may include a plurality of elements such that each element transmits an independent signal. The signals may comprise orthogonal or pseudo-orthogonal signals. Each of the plurality of elements for the transmitter and the receiver may comprise a dipole with a back-plane. Transmitter [111] 110 may be in motion, and not at a fixed position.

[00031] Receiver 102 may be a moving receiver array that includes a plurality of elements such that each element is configured to receive a scattered signal. Further, receiver 102 is configured to receive a set of information relating to the independent signals of each of the first plurality of elements. The radar functions of the disclosed embodiments may be performed using information received by any receiver with suitable [receive] receiving equipment and knowledge of the transmitter waveform codes. Receiver 102 may be in motion, and not at a fixed position. Further, there may be a plurality of receivers, with all the receivers in motion. The receivers may not be coupled together, or in communication, so as to act independently of each other. For example, each receiver may be on moving vehicles within a certain area of emphasis. The receivers within the area may receive the transmitted signals continuously from the transmitters, such as transmitter [111] 110.

[00033] Processing unit 104 may reformulate each of the independent signals provided by receiver 102. Accordingly, each processing unit 104 may form independently all potential beams generated by transmitter [111] 110, or any subset of beams generated by transmitter [111] 110. Because processing unit 104 does not control transmitter [111] 110, a single transmitter may be utilized by multiple receiver/ processing unit combinations. Thus, signals from a single transmitter may be recreated at each receiver, independently of the transmitter and the other receivers.

[00035] According to the disclosed embodiments, radar detection system 10 may provide the mechanism to obtain radar parameters, such as ground moving target indication ("GMTI"), air moving target indication ("AMTI"), and synthetic aperture radar ("SAR") imaging by forming simultaneous transmitter and receiver beams. The gain and directivity of each of the simultaneous transmitter and receiver beams may be comparable to known systems, such as phased array radar and bistatic radar technology. Using radar detection system 10, the transmitter and receiver beamforming may be controlled by a user within the field of view of the transmitter, provided the user has knowledge of the radar waveform codes. Thus, radar functions may be provided on-demand over wide geographical areas. The radar transmitter may be shared by multiple users over a wide geographical area without the need for specific requirements to task the source of illumination. For example, referring to Fig. 1, transmitter [111] 110 and receiver 102 are not coupled to each so as to exchange data.

[00041] Radar system 10 may share transmitter resources among a wide variety of users such that a prior[i] tasking or the control of transmitter resources is not critical. Additional processing, intelligence, or tasking is avoided at the transmitter, other than operations to code independent waveforms. Radar functions may be performed against objects, or targets, anywhere within the field-of-view of the independently coded sub-arrays within the transmitter. Where coding occurs at the element level, the radar functions may be performed against objects anywhere in the forward hemisphere of the transmitter array by any user with suitable receiving equipment and knowledge of the transmitter waveform codes. The transmitted signal waveforms may be reconstructed at the [receiever]receiver, thus, possibly eliminating the need for a directed transmitted beam.

[00050] Sub-apertures 310, 320, and 330 also include receivers 316, 326, and 336, respectively. Receivers 316, 326, and 336 may be low-noise, high dynamic range receivers. In receivers 316, 326 and 336, sub-aperture formation may be used to reduce cost and complexity of the radar system if the adaptive broadcast radar transmitter, such as transmitter 200, is utilized for surveillance or reconnaissance in a restricted area. To support operations that desire wide area coverage, the radar system may operate at a lower frequency to reduce system complexity without a corresponding reduction in coverage. Receivers 316, 326, and 336 are coupled to adaptive broadcast radar transmitter channel demultiplexers 350, 360, and 370, respectively. Preferably, <u>each</u> demultiplexer is dedicated to each <u>respective</u> sub-aperture.

[00066] The STAP covariance may be modeled as a diagonal matrix, independently of delay and time to provide simultaneous fixed transmitter and receiver beamforming. Weight vectors are proportional to the steering vector and provide the amplitude and phase adjustments desired to steer the transmitter and receiver beams in a particular direction. Diverse types of fully adaptive and partially adaptive STAP algorithms designed to adapt both transmitter and receiver antenna patterns may be specified in terms of the weight vectors. For example, bistatic DPCA may be implemented using steering vector components [may be] defined by:

$$G = \begin{Bmatrix} g_j \otimes g_k \\ -2g_j \otimes g_k \\ g_j \otimes g_k \end{Bmatrix}$$

[00074] Step 616 executes by generating the data quads according the indices. The indices, (j, k, m, n) may define points in the four-dimensional data quads. Standard index mapping may be used to transform the dimensional data vector into a one-dimensional vector, χ_μ. Step 618 executes by estimating the measurement covariance, R, for the vector disclosed above. Standard STAP techniques may be applied to estimate the measurement covariance, or $R_{\mu\mu'} = \langle \chi_{\mu} * \chi_{\mu'} \rangle$. Step 620 executes by computing the STAP weight vectors. The STAP weight vectors, W, may be computed in terms of the covariance and the steering vector, G, or <u>$W = R^{-1}G$. As disclosed with reference to Fig. 5, the weight vectors provide the amplitude and phase adjustments desired to steer beams in a particular direction.</u>

[00075] [$W = R^{-1}G$. As disclosed with reference to Fig. 5, the weight vectors provide the amplitude and phase adjustments desired to steer beams in a particular direction.]

[00080] Step 704 executes by generating an integral of the received signal. The received signal may be re-expressed in terms of a continuous integral over the delay measurement, τ, or

$$X_p(k,t) = \sum_{j=0}^{J-1}\left\{H_{0:j,k}(t)V_{jk}(t) + \int_{\Delta\tau} H_{c:j,k}(\tau',t)V_{jk}(t-\tau')d\tau'\right\} + \nu(t)$$

where $V_{jk}(t) \equiv e^{i\psi^{j}k(t)}$.

[00093] Step 812 executes by performing motion compensation to remove time dependent phase delays between transmitter 200 and receiver 300. Motion compensation may be performed independently for each sub-aperture of receiver 300. Step 814 executes by determining the delay and doppler, if applicable, for the received signal. This information may be placed into a channel transfer function. Once the motion compensation and delay/doppler steps are complete, Step 816 executes by determining the remaining characteristics of the transmit signal.

End of Appendix